touch panel may provide a clicking sensation similar to that felt when pressing a key or button of a mechanical keypad.

[0049] The magnitude of the displacement d of the pressed second area II depends on the gap between the upper and lower substrates **120** and **110**, that is, variation in the gap between the upper and lower substrates **120** and **110**. Various methods can be used to measure such a variation in the gap. For example, the variation in the gap size may be sensed according to a variation in capacitance between the driving electrodes of the upper and lower substrates **120** and **110**. The details for a method of measuring variation in capacitance is known in the technical art related to capacitive type touch panels, and accordingly a detailed description thereof will be omitted.

[0050] In the touch panel according to the above-described embodiment, a user's input is recognized in association with when the driving voltage is cut off. For example, a time at which the driving voltage is cut off may be recognized as a time at which a user's input happens. If the driving voltage is cut off, the corresponding electric field disappears. Accordingly, occurrence of input errors due to unintended slight contact may be avoided.

[0051] Alternatively, in the touch panel according to the above-described embodiment, a user's input signal may be recognized in multiple stages regardless of a time when the driving voltage is cut off. For example, degrees of force to be applied on the second area II are divided into a plurality of levels, and when a user touches the touch panel, a level of the user's input may be recognized as one of the levels. In this case, a degree of force applied by a user may be distinguished by a variation in the gap between the upper and lower substrates, that is, for example, by a variation in capacitance due to a variation in the gap.

[0052] In this way, after a user presses a button and then the user's input is recognized, the driving voltage may continue to be applied to the touch panel or no driving voltage may be applied to the touch panel. In the case where the driving voltage continues to be applied to the touch panel, the same type of driving voltage applied just before the driving voltage is applied is applied to restore the previous button (that is, since the viscosity of the electro-rheological fluid in the same area increases), or a driving voltage for another application is applied to form a different type of button on the touch panel (that is, since the viscosity of electro-rheological fluid in another area increases). Also, in the case where no driving voltage is applied, there is no area where the viscosity of the electro-rheological fluid increases, so that buttons are no longer created on the touch panel.

[0053] FIGS. **4**A and **4**B are views showing an example of the structure of the touch panel **100**, wherein FIG. **4**A is a perspective view showing separated upper and lower substrates of the touch panel and FIG. **4**B is a cross-sectional view of the touch panel with the upper and lower substrates coupled together, cut along the longitudinal direction of the upper electrode pattern. In FIGS. **4**A and **4**B, the thicknesses of substrates, etc., the gap between substrates, the sizes, numbers and arrangements of other components, and so on are exaggerated or simplified for clarity.

[0054] Referring to FIGS. **4**A and **4**B, the touch panel **100** includes a lower substrate **110**, an upper substrate **120**, an electro-rheological fluid **130**, spacers **136**, driving electrodes **140** and sealant **150**. The lower substrate **110** may be a transparent glass substrate and the upper substrate **120** may be a deformable transparent polymer film. The lower substrate **110** is spaced from the upper substrate **120** by a gap, and in the gap, the electro-rheological fluid **130** and spacers **136** are located. The touch panel **100** may further include a controller and a sensing unit, both of which are not shown in the drawings.

[0055] The spacers **136** are very small, elastic elements and may be made of, for example, elastomer or the like. A very large amount of the spacers **136** is evenly distributed throughout the entire space of the gap. For example, on a typical touch panel, the amount of spacers may be on the order of a few hundred spacers. The spacers **136** function to structurally support the upper substrate **120**. When no supply voltage is supplied, the spacers **136** allow the user contact surface S to be as flat as possible. If a force is applied to the upper substrate **120**, the spacers **136** provide the upper substrate **120** with repulsive force.

[0056] The electro-rheologic fluid **130** is filled in the gap between the lower substrate **110** and the upper substrate **120**. In the electro-rheological fluid **130**, liquid whose refraction index is adjustable may be used as dispersive medium **132** so as to minimize the interfacial reflection between interfaces existing inside the touch panel **100**, that is, between the upper and lower substrates **120** and **110** and the electro-rheological fluid **130**, and between the driving electrodes **140** and the electro-rheological fluid **130**. For example, fluid whose refraction index is adjustable with respect to a material forming the driving electrodes **140** may be used as dispersive medium **132** of the electro-rheological fluid **130**. Also, the sealant **150** is applied at the edges of the gap to seal the dispersive medium **132** between the upper substrate **120** and the lower substrate **110**. The sealant **150** may be a plastic resin or the like. However, the sealant **150** is not particularly limited thereto.

[0057] The driving electrodes **140** are components designed to form an electric field locally between the upper and lower substrates **120** and **110**. In the touch panel **100**, by varying the combinations of the driving electrodes **140** to form an electric field, the numbers, sizes, shapes, etc. of button areas created on the user contact surface may be reconfigured. For example, in the case of a touch panel which provides a single fixed type of button area, the location, number, size, shape, etc. of the driving electrodes **140** may also be fixed in consideration of the location, number, size, shapes, etc. of the button area. The electrode design depends on the sensing precision and not the driving ERF. Thus, the electrode size may be smaller than the size of the smallest button area. Thus, for example, in the case of a touch panel which provides various types of button area, a plurality of driving electrodes may be arranged in a matrix form throughout the entire area of the touch panel **100**. In this case, by varying the combinations of the driving electrodes **140** to which a driving voltage is applied, various types of input button areas may be delimited on the user contact surface of the touch panel **100**.

[0058] FIGS. **4**A and **4**B show examples where the driving electrodes **140** are arranged in a matrix form. Referring to FIGS. **4**A and **4**B, a line-type lower electrode pattern **142** is formed on the upper surface of the lower substrate **110**, and a line-type upper electrode pattern **144** is formed on the lower surface of the upper substrate **120**. The lower electrode pattern **142** extends in a first direction, and the upper electrode pattern **144** extends in a second direction. As one example, the second direction may be perpendicular to the first direction. Accordingly, the driving electrodes **140** are arranged in a matrix form at intersections of the lower electrode pattern **142**